OIPE
MAR 0 7 2007
PATENT & TRADEMARK OFFICE

CLAIMS

What is claimed is:

Claim 1. (Currently amended) ~~Method~~ A method of defense-in-depth ultrasound intrusion detection that provides for sufficient enhancement of the distance of location and detection of an intruder with airborne ultrasound throughout enclosed premises of buildings, near field zone and circumjacent air vicinity of [[the]] ~~hemispheric~~ [[,i.e.]] a dome-type, volumetric room that surrounds a protected object, including the techniques of:

arrangement of the ~~said entire~~ volumetric room into ~~the physical~~ [[, i.e.]] ~~substantial~~ [[,]] ~~tightly juxtaposed and preferably~~ geometrically closed areas that constitute ~~the~~ a spatial multi-echelon infrastructure of ~~the~~ a defense-in-depth automatic intrusion protection system; and

commissioning each of ~~said~~ single-level or multi-sublevel echelons ~~with the specific format~~ of intrusion detection wherein: ~~the~~ central indoor echelon (**C**) containing the enclosed premises of a protected object is being commissioned to detect ~~the~~ an intruder's presence and direction of ingress or egress motion; ~~the~~ an outdoor short-range echelon (**S**) of the near field zone adjoining the buildings, works and installations of a protected object is ~~being~~ assigned to detect the presence and locality of an intruder ~~as far as~~ relating to the direction of [[its]] the intruder's motion; ~~the~~ an outdoor long-range echelon (**L**) of ~~the~~ a circumjacent air vicinity of ~~the~~ a layout area of a protected object ~~is being charged with detection~~ detects of the intruder's presence, and speed and direction of [[its]] the intruder's motion; and

rating the size of each particular echelon in the designed prevailing direction of intrusion location ~~to the dimension~~ at a distance that should not exceed the distance at which ~~the~~ an airborne ultrasound wave attenuates along its incidence and reflection trip to the value less than the dead band of ~~the~~ ultrasonic transceivers where said transceivers are being chosen regarding their operating frequency and prognosticated conditions of ~~the~~ ambient air around a protected object; and

application of different modes of response of ~~the~~ an emitted ultrasound signal, at least ~~the~~ reflection, refraction by edge diffraction and interference with shadowing by an intruded target, in accordance with ~~the specific format~~ a procedure of intrusion detection and presumptive spatio-temporal conditions of intrusion location in every echelon ~~in particular~~; and

designing predictive models of intrusion vulnerability of each echelon and the entire area of the protected object regarding previously simulated model of presumptive spatio-temporal behavior of an intruding ~~subject or a trespasser~~ object along ~~their~~ its possible routings; and

plotting ~~the~~ an intrusion event tree that reveals cause-effect relations between an intrusion

occurrence and subsequent menaces[[, i.e.]] ~~threats~~[[,]] to echelons and their sublevels therein, and to a protected object integrally where for simple arrangements of ultrasonic intrusion detection systems with ~~a couple of~~ three or less echelons, each comprising ~~a few~~ separate sublevels with single units of protected equipment, the event tree ~~can be~~ is composed with use of ~~theory~~ techniques of combinations and ~~technique of~~ situational logic transition, whereas for the ~~complex~~ arrangements [[(i.e.]] ~~for the multi-echelon systems~~ of three or more echelons with a plurality of protected units of equipment installed in each echelon or in its sublevels[[)]] ; the event tree ~~should be~~ is composed on the basis of complete Markov models with Boolean transition logic; and

derivation of mathematical expressions ~~for the system~~ of logical equations of said cause-effect relations for the intrusion events in every echelon and its sublevels therein, ~~the~~ a verifying logical matrix of intrusion justification, ~~the~~ a logical decision matrix of inter-echelon cause-effect relations and factors of menaces, ~~the~~ a generalized resolving logical equation; and

drawing up ~~the~~ control software algorithm for governing at least: ~~the~~ a resolver, which handles the system of said echelons' logical equations, the verifying logical matrix, the logical decision matrix and the generalized resolving logical equation; data control block that operates ~~the~~ modes of locating with ultrasound beams and ~~the~~ a data acquisition procedure; and system control block that forms and presents ~~the~~ signals of intrusion detection and justification, and ~~the~~ triggering signals of intrusion prevention, protection and defense; and

establishing ~~the~~ a software-programmable inter-echelon informational and processing logical interrelation among all the juxtaposed and non-adjacent echelons wherein said interrelation is ~~being~~ automatically treated and handled in ~~the~~ a real time domain by ~~the~~ said control software algorithm that operates ~~the~~ a continuous status scan of all the ultrasonic transceivers and oppositely aligned pairs of transmitters and receivers in every echelon simultaneously; and which algorithm provides for:

transferring the ~~acquired~~ data of continuous status scan to the ~~said system of~~ echelons' logical equations, verifying logical matrix, and logical decision matrix;

ability of ~~the~~ said resolver to process ~~the~~ acquired data by ~~the~~ said echelons' logical equations, verifying logical matrix, logical decision matrix and generalized resolving logical equation up to the ~~logically correct~~ final ~~decision~~ resolution of the goal function of the intrusion detection and protection method; and

creation and presentation of logically true sequence of ~~the~~ caution and self-checking signals for every intrusion-suspected echelon, signal of intrusion vindication for the ~~really~~ affected

echelon, and final triggering signals of alarm and activation of security measures ~~where the creation and presentation of the said final triggering signals is~~ as the final resolution of the goal function ~~of the present method of ultrasound intrusion detection and protection~~; and

entry of triggering signals for starting ~~said~~ security measures of active and passive protection and defense, which measures include at least: activation of ~~the~~ an alarm system, enclosing ~~the~~ movable physical barriers around the protected works and installations, hence entrapping ~~a trespasser on its actual routing preferably~~ an intruding object inside echelon **C**, application of disabling tear gas, involving ~~the~~ guard troops, deploying inflatable air obstacles in echelons **S** and **L** or opening ~~the~~ defensive fire in echelon **L**.

Claim 2. (Currently amended) ~~Method~~ The method as defined in Claim 1 wherein ~~all the~~ a protected dome-type volumetric room around a critical object is ~~being~~ arranged in several juxtaposed echelons; where

the indoor single-level or multi-sublevel echelon **C** is ~~being~~ arranged inside the enclosed premises of a protected object, in each of which at least one couple of a transmitter and receiver pair is ~~being~~ mounted for inward detection of an intruder by the ultrasound ~~beam~~ beams responding in reflection or refraction by diffraction modes; and where

the outdoor single-level or multi-sublevel echelon **S** of the near field zone adjoining the buildings and installations of a protected object is being shaped to consist of 2-D polygonal or curvilinear plane contours, [[and/]] or 3-D curved surface areas that are connected into ~~the~~ a spatial ~~substantial and~~ solid openwork frame, equipped with ~~the~~ pairs of oppositely directed transmitters and receivers, so that ~~all this~~ the near field zone has been covered by closely adjacent or ~~even~~ overlapped ultrasound beam patterns, which are ~~being~~ designated to respond either in the refraction mode characterized with diffraction of receiver's beam pattern by intruder's edge, or in the mode of interference featured shadowing a receiver's beam pattern by an intruding ~~subject or trespasser~~ object; and further where

the single-level or multi-sublevel echelon **L** of the circumjacent air vicinity of the layout area of a protected object is ~~being~~ shaped into 3-D curved surface in the form of ~~substantial~~ spatial lattice equipped with outwardly directed transceivers that function by ~~the~~ techniques of constant vectoring or scanning ~~the~~ solid angles that overlap each other, and operate in the mode of continuous emission of ultrasound beams and occasional reception of ultrasound beams reflected from a target.

Claim 3. (**Currently amended**) ~~Method~~ The method as defined in Claim 2, including the steps of:

shaping ~~the~~ inner boundaries of outdoor single-level or multi-sublevel echelon **S** of the near field zone in compliance with layout and overground contours of installations and works of a protected object, while shaping the outer frontiers of the ~~said~~ echelon **S** in compliance with layout and outside contours of prohibited areas and access roads around works and buildings of a protected object; and

division of the outdoor echelon **S** of the near field zone into ~~a few~~ separate sublevels and designing the geometrical shapes and dimensions of said 2-D polygonal or curvilinear contours, or 3-D curved surface areas in accordance with:

~~the~~ spatio-temporal parameters of airborne ultrasound propagation towards ~~the~~ previously designed prevailing directions of ultrasonic location in forecasted conditions of the air ambient, while admitting the airborne ultrasound wave attenuation along its one-way emission trip from a transmitter to the opposite receiver to have occurred to the value not less than the dead band of ~~the chosen~~ ultrasonic ~~transducers~~ transceivers;

the presumptive spatio-temporal behavior of an ~~intruder or trespasser~~ intruding object over the terrain of the ~~said~~ echelon **S** of a protected object regarding ~~their~~ its possible routings;

the available capabilities ~~to cover all the~~ of covering said ~~surfaces~~ surface areas with the ultrasound beam patterns chosen regarding ~~the said~~ conditions of ultrasound propagation and applied either in stationary or scanning modes of surveillance; and

shaping the echelon **L** of circumjacent air vicinity of the layout area of a protected object so that it is ~~being done~~ open outwardly to the dome-type ~~surveyed~~ room whereas the inside geometrically closed frontier of echelon **L** is ~~being~~ configured as the openwork spatial lattice, enveloping the external frontier of the outdoor echelon **S** ~~of the near field zone~~ , otherwise ~~the~~ said both frontiers are ~~being~~ constructed to coincide in part or in full.

Claim 4. (**Currently amended**) ~~Method~~ The method as defined in Claims1 or 3, including the steps of:

~~working out~~ composing the graphic-analytical model of intrusion vulnerability for each echelon ~~with regard to the supposed options~~ regarding different situations of spatio-temporal ~~purposeful~~ behavior of ~~intruder or trespasser~~ the intruding object along ~~their~~ its possible routings inside premises of the central echelon **C**, around buildings and works of short-range echelon **S**, within reach of ultrasound location inside the space of the long-range echelon **L**, where ~~the said~~ ~~options~~

~~of their~~ ingress or egress routings thru every echelon are ~~being~~ searched ~~with taking to account~~ according to the layout and architectural features of the available protective barriers against an intrusion, and various assumed ways of the ~~trespassers~~ [['']] intruder's accessibility to the ~~critical~~ works and installations therein; and

verification of geometrical shape and dimensions of every echelon with respect to its predictive graphic-analytical model of intrusion vulnerability where ~~the~~ said verification is ~~being~~ accomplished by comparison of spatio-temporal parameters of intruder's ~~or trespasser's purposeful~~ behavior with spatio-temporal parameters of ultrasound beams' propagation and signaling response in the previously designed prevailing directions of location.

Claim 5. (Currently amended) ~~Method~~ The method as defined in Claims 1 or 2 wherein the technique of ultrasound intrusion detection for each of said echelons is being chosen in the steps of:

selection of modes of ultrasonic beam response regarding commissioning of ~~the specific format of intrusion detection which~~ every echelon ~~has been commissioned with~~ and in compliance with previously ~~worked out the~~ composed predictive graphic-analytical models of intrusion vulnerability for each ~~surveyed~~ echelon; and

definition of ~~the~~ an erection diagram for disposition of ultrasound transceivers installed inside premises of the echelon **C** and mounted along the circumference of the echelon **L**, and for arrangement of the oppositely aligned pairs of transmitters and receivers along either adverse sides of the integral contour of single-level echelon **S** or adverse sides of the joining contours of juxtaposed portions of multi-sublevel echelon **S** where ~~the~~ said disposition and arrangement are ~~being~~ schematized in the form of ~~the~~ straight-line or elbow-type rows, planar array or in the spatial lattice for each of ~~the~~ said echelons with respect to ~~the~~ said predictive echelons' graphic-analytical models of intrusion vulnerability and with ~~obeying the~~ requirements to close and ~~even overlapping~~ overlap coverage of at least possible routings of ~~intruders or trespassers~~ intruding objects with ultrasound beam patterns operating in stationary or in scanning mode of location.

Claim 6. (Currently amended) ~~Method~~ The method as defined in Claims 1 or 4 wherein ~~the~~ a generalized graphic-analytical model of intrusion vulnerability for ~~the~~ an entire protected dome-type volumetric room around a critical object is ~~being~~ composed, including the steps of:

designation of available stationary and movable physical barriers ~~for having used them as hindrances to access the critical installations and as entrapments along the presumed routings of an intruding subject or a trespasser where this designation is being fulfilled regarding the previously~~

~~simulated model of the presumptive spatio-temporal behavior of an intruding subject or a trespasser~~ for prevention of the intruding object to the installations and works; and

definition of ~~the~~ territorial contours and limits of operating time, ~~violation of which with the~~ where non-authorized presence or movement of an ~~intruded subject or a trespasser should be~~ intruding object is considered as violation of access mode and ~~the~~ an actual hazardous intrusion; and

plotting the intrusion event tree in the form of graphic representation or table matrices which identify the interrelations of sublevels inside any echelon, and among juxtaposed or non-adjacent echelons that are based on the sequence of the cause-effect events of an intrusion occurrence and definition of the menaces that ~~should~~ appear due to the presence and motion of ~~an intruded subject or trespasser~~ the intruding object, where

the graphic presentation of the intrusion event tree is ~~being~~ fulfilled on ~~the~~ floor plans of enclosed premises of echelon **C** and on the lay-out of the near field zone of echelon **S** for detection of intrusion cause-effect cross-linkages ~~and respective facts~~ of intrusion menaces among sublevels inside echelons, and among juxtaposed and non-adjacent echelons **C**, **S** and **L**; and where

the revealed data of said cross-linkages ~~and facts~~ of intrusion menaces are ~~being~~ used for setting up and analysis of said logical decision matrix, and for setting up said generalized resolving logical equation; and further

setting up the generalized graphic-analytical model in the form of graphic-and-analytical representation of inter-echelon dependable vulnerability at occurrence of one or ~~a few~~ more intrusions in one or all of the echelons, ~~or in some of them simultaneously~~ where the analytical part of graphic-and-analytical representation is ~~being~~ set with use of the ~~deterministic~~ situational logic transition.

Claim 7. (Cancelled).

Claim 8. (Cancelled).

Claim 9. (Currently amended) ~~Method~~ The method as defined in Claims 1 or 4 or 6 wherein the echelons' logical equations are ~~being~~ set up in advance to reveal the ~~factors of~~ menaces inside the echelons and sublevels therein based on ~~the~~ said graphic-analytical models of intrusion vulnerability that is ~~being~~ estimated by ~~the~~ probable cause-effect damages of protected facilities and ~~sequent~~ sequential losses rated on the basis of single-failure criterion, especially of the ~~facilities~~ installations, belonging to some sublevels in one echelon or to different echelons

concurrently; where

the logical decision matrix of the control software algorithm is ~~being~~ designed by placing top-down into the main column all echelons and their ~~the~~ sublevels ~~of the echelons and entire echelons~~ in the order of defense-in-depth structure, beginning from echelon **L**, and further by arranging ~~all~~ factors of menaces, drawn from ~~the~~ said echelons' logical equations, in the rows against the respective ~~echelons' sublevels and entire~~ echelons and their sublevels in the order of ~~the~~ diminishing rate of said factors of menaces; where

the verifying logical matrix is ~~being~~ designed for carrying out logic analysis for ~~trustworthiness~~ integrity of inter-echelon caution and self-checking signals ~~to avoid untruth propositions during~~ for resolution of the goal function by the generalized resolving logical equation of the control software algorithm; and where

~~the~~ said generalized resolving logical equation is ~~being~~ set up in the result of the analysis of logical decision matrix and generalized graphic-analytical model of intrusion vulnerability with regard to the intrusion cause-effect cross-linkages among sublevels inside echelons, and among juxtaposed and non-adjacent echelons **C**, **S** and **L**.

Claim 10. (Currently amended) ~~Method~~ The method as defined in Claims 1 or 9 wherein the goal function of ultrasound intrusion detection is ~~being~~ iteratively resolved during continuous status scan and data acquisition ~~by the sequential procedure~~ in the steps of:

solution of the echelons' logical equations for justification ~~the fact~~ of intrusion menace; and

carrying-out running analysis of acquired facts of intrusion menaces by logical decision matrix; and

processing the generalized resolving logical equation by ~~the~~ said control software algorithm with respect to the ~~said~~ verifying logical matrix.